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Resource Assessment of the In-Place and Potentially Recoverable Deep Natural Gas Resource of the Onshore Interior Salt Basins, North Central and Northeastern Gulf of Mexico

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Abstract

The principal research effort for Year 3 of the project has been resource assessment. Emphasis has been on estimating the total volume of hydrocarbons generated and expelled and the potential amount of this resource that is thermogenic (deep) gas in the North Louisiana Salt Basin, the Mississippi Interior Salt Basin, the Manila Subbasin and the Conecuh Subbasin. Other tasks for Year 3 include assessing the potential volume of gas in deeply buried reservoirs as a result of thermal cracking of entrapped liquid hydrocarbons being converted to gas and identifying areas in the study area with high potential for the recovery of deep gas.

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Introduction

The University of Alabama and Louisiana State University have undertaken a cooperative 3-year, advanced subsurface methodology resource assessment project, involving petroleum system identification, characterization and modeling, to facilitate exploration for a potential major source of natural gas that is in deeply buried (below 15,000 ft) reservoirs in the onshore interior salt basins of the north central and northeastern Gulf of Mexico areas. The project is designed to assist in the formulation of advanced exploration strategies for identifying deeply buried natural gas reservoirs in domestic basins.

The results of the project should serve to enhance exploration efforts by domestic companies in their search for new petroleum resources; especially those in deeply buried (below 15,000 ft) natural gas reservoirs, and should support the domestic industry's endeavor to provide an increase in reliable and affordable supplies of fossil fuels.

Executive Summary

The principal research effort for the first half of Year 3 of the project has been resource assessment. Emphasis has been on estimating the total volume of hydrocarbons generated and expelled and the potential amount of this resource that is thermogenic (deep) gas in the North Louisiana Salt Basin, the Mississippi Interior Salt Basin, the

Manila Subbasin and the Conecuh Subbasin. Other tasks for Year 3 include assessing the potential volume of gas in deeply buried reservoirs as a result of thermal cracking of entrapped liquid hydrocarbons being converted to gas and identifying areas in the study area with high potential for the recovery of deep gas.

The estimate of the total volume of hydrocarbons generated and expelled for the North Louisiana Salt Basin using a petroleum system approach is comparable to Zimmerman's (1999) estimate of the total volume of hydrocarbons generated/expelled for this basin. The estimate of the total volume of hydrocarbons generated and expelled for the Mississippi Interior Salt Basin in this study is consistent with the findings of Mancini et al. (2003) for the petroleum system in this basin. In this study, the hydrocarbons generated for the Manila Subbasin and the Conecuh Subbasin include liquid hydrocarbons. The condensate and associated gas in the reservoirs in these subbasins are interpreted to be the result of thermal cracking of liquid hydrocarbons entrapped in the reservoirs. Upper Jurassic and Lower Cretaceous facies have high potential for the recovery of undiscovered and underdeveloped deep gas in the North Louisiana and Mississippi Interior Salt Basin.

Project Objectives

The objectives of the study are: to perform resource assessment of the thermogenic gas resource in deeply buried (>15,000 ft) natural gas reservoirs of the onshore interior salt basins of the north central and northeastern Gulf of Mexico areas through petroleum system identification, characterization and modeling and to use the petroleum system based resource assessment to estimate the volume of the thermogenic (deep) gas resource

that is available for potential recovery and to identify those areas in the interior salt basins with high potential for thermogenic (deep) gas reservoirs.

The project objectives will be achieved through a 3-year effort. First, emphasis is on petroleum system identification and characterization in the North Louisiana Salt Basin, the Mississippi Interior Salt Basin, the Manila Subbasin and the Conecuh Subbasin of Louisiana, Mississippi, Alabama and Florida panhandle. This task includes identification of the petroleum systems in these basins and the characterization of the underburden, overburden, source, reservoir and seal rocks of the petroleum systems and of the associated petroleum traps. Second, emphasis is on petroleum system modeling. This task includes the assessment of the timing of thermogenic gas generation, expulsion, migration, entrapment and alteration (thermal cracking of oil to gas). Third, emphasis is on resource assessment. This task includes the estimation of the hydrocarbon resource generated, the assessment of the generated hydrocarbon resource that is classified as thermogenic gas, the estimation of the thermogenic gas that was expelled, and potentially migrated and entrapped, and the assessment of the potential volume of gas in deeply buried (>15,000 ft) reservoirs resulting from the process of thermal cracking of liquid hydrocarbons and their transformation to gas in the reservoir. Fourth, emphasis is on identifying those areas in the onshore interior salt basins with high potential for deeply buried thermogenic gas reservoirs.

Experimental

Work Accomplished (Table 1)

In-Place Resource Assessment—Work has been completed on estimating the total volume of hydrocarbons generated and the potential amount of this resource that is

classified as thermogenic gas in the North Louisiana Salt Basin, the Mississippi Interior Salt Basin, the Manila Subbasin and the Conecuh Subbasin. This assessment involves estimating the amount of the gas resource that is generated directly from the source rock and assessing the potential volume of gas in deeply buried (>15,000 ft) reservoirs as the result of cracking entrapped liquid hydrocarbons being converted to gas. The method of Schmoker (1994) and the use of petroleum system software applications (Platte River) were used in the estimation of the total volume of hydrocarbons generated and expelled in the interior salt basins.

Potentially Recoverable Deep Gas Volume— Work has been completed on estimating the generated total resource and the thermogenic (deep) gas resource in the North Louisiana Salt Basin, Mississippi Interior Salt Basin, Manila Subbasin and Conecuh Subbasin that was expelled. The hydrocarbons generated for the Manila Subbasin and the Conecuh Subbasin include liquid hydrocarbons. The condensate and associated gas in the reservoirs in these subbasins are interpreted to be the result of thermal cracking of liquid hydrocarbons entrapped in the reservoirs.

***Oil Converted to Gas Assessment*—**The potential volume of gas in deeply buried reservoirs as a result of the thermal cracking of entrapped liquid hydrocarbons being converted in the reservoirs in the Manila and Conecuh Subbasins has been assessed.

***Identification of Deep Gas Resources*—**The areas in the onshore interior salt basins with high potential for the recovery of thermogenic (deep) gas have been identified.

Work Planned

***Technology Transfer*—**A workshop is scheduled for November 8, 2006, on the results of this project. The workshop will be sponsored by the Eastern Gulf Region of the Petroleum Technology Transfer Council and held in Tuscaloosa, Alabama.

Results and Discussion

The estimate of the total volume of hydrocarbons generated and expelled for the North Louisiana Salt Basin in this study using a petroleum system approach compares favorably with the total volume of hydrocarbons generated/expelled published by Zimmermann (1999). The estimate of the total volume of hydrocarbons generated and expelled for the Mississippi Interior Salt Basin in this study is consistent with the findings published by Mancini et al. (2003) for the characteristics of the Smackover petroleum system inherent to this basin.

The apparent gas-prone nature of the North Louisiana Salt Basin and particularly the Monroe Uplift area has been of study by previous workers, including Zimmerman and Sassen (1993) and Lewan (2002). These researchers agree that the original source of the gas produced from reservoirs in the Monroe Uplift area is the lower Smackover beds, although Lewan (2002) states that much of the gas being produced today in this basin is a result of thermal cracking of liquid hydrocarbons entrapped in deeply buried reservoirs being converted to gas. These authors also concur that the gas is thermogenic in origin and that the timing of igneous activity, erosion, and migration play an important role in the presence of the large volume of gas in this area.

The potential volume of gas in deeply buried reservoirs as a result of thermal cracking of entrapped liquid hydrocarbons being converted to gas in the reservoirs was evaluated using the methodology of Claypool and Mancini (1989). This method was used for the Manila and Conecuh Subbasins because although these are oil prone basins, there is gas

entrapped in reservoirs below 15,000 ft. in certain fields (Big Escambia Creek and Flomation fields).

The areas in the North Louisiana and Mississippi Interior Salt Basins with high potential for deeply buried gas reservoirs have been identified using the petroleum system and resource assessment studies.

The petroleum system studies of the Manila and Conecuh Subbasins indicate that these subbasins are thermally mature for oil generation and expulsion, but not thermally mature for thermogenic gas generation and expulsion. The deep gas (>15,000 ft) produced from reservoirs in the Manila and Conecuh Subbasins is interpreted to be the result of thermal cracking of entrapped hydrocarbons being converted to gas in the reservoirs in this basin.

In the North Louisiana Salt Basin, several parishes have high potential for deeply buried gas reservoirs. This thermogenic gas is expected to be found in Upper Jurassic Smackover, Haynesville and Cotton Valley facies and Lower Cretaceous Hosston, Sligo, James, Glen Rose (Rodessa, Mooringsport, and Rusk), and Paluxy facies.

In the Mississippi Interior Salt Basin, several counties have high potential for deeply buried gas reservoirs. The reservoir characteristics and parameters of these units are expected to be similar to those of the units in discovered fields in this basin. Potential petroleum reservoirs include Upper Jurassic and Cretaceous fluvial-deltaic, shoreline, marine bar, shallow shelf sandstone and deep water sandstone facies, and carbonate shoal, shelf, reef, and slope facies.

Conclusions

The project work has been completed and the final report for the project is near completion.

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Table 1

Milestone Chart—Year 3

	O	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**
In-Place Resource Assessment												
	xx	xx	xx									
Recoverable Deep Gas Volume												
				xx	xx	xx	xx					
Oil Converted to Gas Assessment												
								xx	xx			
Identification of Deep Gas Resources												
										xx	xx	xx

Work Planned	
Work Completed	xx